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CENTRAL INTELLIGENCE AGENCY
INFORMATION FROM
FOREIGN DOCUMENTS OR RADIO BROADCASTS

REPORT

CD NO.

50X1-HUM

COUNTRY	USSR	DATE OF INFORMATION	1949
SUBJECT	Scientific - Radioactive soils		
HOW PUBLISHED	Irregular publication	DATE DIST.	27 Jan 1951
WHERE PUBLISHED	Moscow	NO. OF PAGES	3
DATE PUBLISHED	1949		
LANGUAGE	Russian	SUPPLEMENT TO REPORT NO.	

THIS IS UNEVALUATED INFORMATION

SOURCE Trudy Biogeokhimicheskoy Laboratorii, Vol IX, 1949, Second Printing Office, Academy of Sciences USSR.

SOVIET RESEARCH ON RADIOACTIVE SOILS

Growing Soviet interest in radioactive substances is reflected in an increase of research reports on the concentration of materials in soils. K. G. Kunasheva (1) has been particularly active in studies on the concentration of radium in various parts of plants which had been grown in test soils containing various concentrations of radium. This study is one aspect of research being conducted to determine the migration of radioactive elements in the biosphere.

Much useful data was obtained. It was shown that plants grown on specially prepared radium-containing media had radium distributed throughout their systems; the greatest concentrations were found in the root systems, which, however, were proportionate to the concentration of radium in the culture media. Of great interest was the fact that the amount of radium in the above-surface parts of the plant was comparatively higher than the amount of radium in the nutrient media. This phenomenon was attributed to the accumulation of radium as the plant develops.

A special study was conducted to determine the amount of radium in plants which were obtained from Versala in 1932. It was noted that where the soil contained 10^{-12} g of radium per gram of soil, there were 445 x 10^{-12} g of radium per kilogram of dry leaves, 118.4 x 10^{-12} g per kilogram of dry stalks, and 7.5 x 10^{-12} g of radium per kilogram of dry seeds.

V. I. Baranov and A. P. Novitskaya (2) conducted a series of basic studies on radium-containing mineral muds in Odessa, Saki, etc. At first there was little interest in these radioactive muds because of their very low radium content, but in recent years interest has increased due to the possibility of using natural or artifical radioactive muds obtained from Kolop Health Resort, Hungary, and the Sungul' Health Resort, USSR. Ratios of radioactivity due to radium and radon, respectively, were determined for muds obtained from the Kuyal'nitskiy estuary (sea-bottom mud), Krainka and Sungul' (peat muds), and sapropelite muds, also from Sungul'.

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The authors did some incidental research to determine the thorium and radium ratio in muds, as a means for determining the source of radioactivity in muds. They found that (a) if this ratio is much higher than in surrounding rock occurrences, radium is being absorbed by plants or mud (thorium is not washed out from rocks to an appreciable extent); (b) some muds do not contain radium at all; therefore radioactivity is due exclusively to the presence of radon which is derived from the radon content of water in which the mud was formed. It was determined that the coefficient of diffusion of radon in organic muds (Sungul' and Vishnevyye Mountains) was less then one centimeter per 24 hr. At temperatures of 46°, this diffusion proceeds at the rate of 0.62 cu cm per 24 hr.

Interesting data was obtained from studies on mineral sea-bottom muds. The diffusion at 46° was 1.4 sq cm per 24 hr.

Further studies conducted by the authors at the Radiological Laboratory, Central Institute for Health Resorts, Moscow, showed that muds which were generally used for therapeutic purposes did not have a very high content of radon or sufficient radioactivity produced by any other substance. It was therefore necessary to process these muds and give them an artifical radon content. It was pointed out that this fact is a peculiarity because in nature, peloids (a class of muds including therapeutic muds) have a high absorption coefficient with respect to many substances, because of their highly colloidal nature. Muds utilized for these experiments were obtained from the Kuyal'nitskiy estuary (Odessa) and from the Krainka Health Resort. Some of the samples were consigned to the Geochemical Laboratory, Central Institute for Health Resorts, where studies were conducted to determine the degree of absorption of gases by therapeutic muds.(3)

The radium emanations used in the artificially fortified muds are added by saturating the mud thoroughly with an aqueous solution or by adding the solution carefully and heating the mud simultaneously. Due to the very low rate of diffusion these muds can be stored for long periods of time without losing their effect, and with very small losses of radioactivity. A special series of experiments conducted with therapeutic peat muds obtained from Kazan' showed that it was possible to saturate these muds very simply and with only about 40 percent of the amount of radon previously required. Experiments were also carried out on the diffusion in muds of thorium emanation.

Various methods have been developed for utilizing radon-containing and radioactive muds for therapeutic purposes. The generally accepted therapeutic method involves baths, but in some cases patients are submitted to treatments involving the inhalation of a mixture of air and a predetermined amount of radon.(4)

Radium-containing substances used in medical practice frequently contain traces of mesothorium and other thorium products, with the result that most of these inhalations include radon and thoron. These two substances, however, have different half-lives, with the result that thoron remains in the air and is inhaled for a slightly longer period than radon. As a result it would be interesting to determine the effect of thoron on the respiratory function of humans.

Several tests were conducted, primarily to determine the amount of thoron retained in the lungs subsequent to the inhalation treatment. It was of interest that after ten inhalations the amount of thoron retained in the lungs remained stable. A special formula was worked out to determine the relationship between the thoron inhaled and the thoron exhaled. In its simplest form it is $T_n = T_o B n$, where $B = 1 \frac{V_1}{V_1+V_2}$; T_o = the initial amount of thorium in the respiratory passages; V_1 = degree of air exchange; and V_2 = the amount of air retained in the lungs, and which is partially mixed with the exhaled air at each exhalation. The value of B was determined experimentally and was found to be about 0.6 and that the relationship of the exchange $\frac{V_1}{V_2}$ was equal to 0.67.

As a result of these computations and investigations it was possible to deduce the amount of thoron which enters the blood in inhalation by measuring the content in the air which is exhaled.

The authors conclude their article by suggesting that their research will have much bearing on thoron-containing-air inhalation therapy.

SOURCES

1. K. G. Kunasheva, "Raspredeleniye Radiya v Otdel'nykh Chastyakh Rasteniy Vyrashchenuykh v Srede s Razlichnoy Kontsentratsiyev Radiya" (Distribution of Radium in Various Parts of Plants Raised on Media Containing Various Concentrations of Radium)

2. V. I. Baranov and A. P. Novitskaya, "Diffuziya Radona v Prirodnykh Gryazakh" (Diffusion of Radon in Natural Muds)

3. V. I. Baranov and A. P. Novitskaya, "Absorbtsiya Radona Prirodnymi Gryazydmi" (Absorption of Radon by Natural Muds)

4. V. I. Baranov and A. P. Novitskaya, "O Dinamike Gazoodmena pri Dykhanii Vozdukhom, Soderzhashchim Toron (Emanatsiya Toriya)" (Dynamics of Gas Exchange during Inhalation of Thoron- (thorium radiation) Containing Air).

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